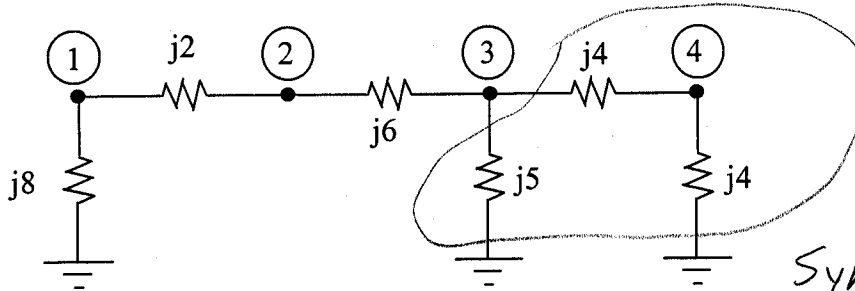


Clearly show all work needed to obtain your answer.

Use the definition of Z-matrix elements to find matrix elements  $z_{11}$ ,  $z_{12}$ ,  $z_{13}$ ,  $z_{14}$ .

$$j5 \parallel j4 = j \left[ \frac{40}{13} \right] = j3.08$$

Symmetry  $z_{ij} = z_{ji}$   
(except where phase shifting transformers exist)

$$z_{ij} = \frac{\partial V_i}{\partial I_j} = \frac{V_i}{I_j} \Big|_{I_k=0, k \neq j}$$

$$z_{11} = j8 \parallel (j2 + j6 + j3.08) = j8 \parallel j11.08 = j4.65$$

$$z_{21} = z_{11} \left( \frac{V_2}{V_1} \right) = j4.65 \left( \frac{6+3.08}{2+6+3.08} \right) = j3.81 = z_{12}$$

$$z_{31} = z_{11} \left( \frac{V_3}{V_1} \right) = j4.65 \left( \frac{3.08}{2+6+3.08} \right) = j1.293 = z_{13}$$

$$z_{41} = z_{31} \left( \frac{V_4}{V_3} \right) = j1.293 \left( \frac{4}{4+4} \right) = j0.647 = z_{14}$$

Voltage Divider

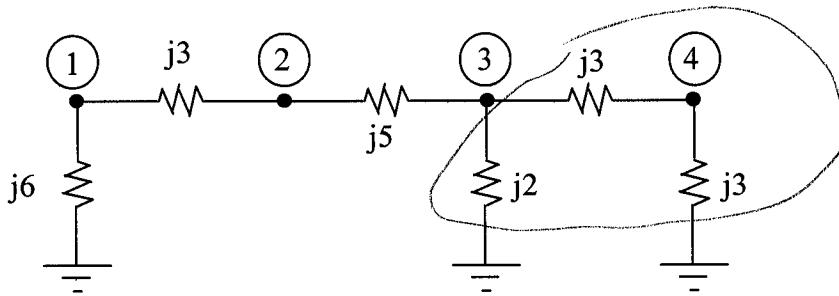
Check  $z_{14}$ ,

$$z_{44} = j4 \parallel (j4 + j5 \parallel (j6 + j2 + j8)) = j4 \parallel (j4 + j5 \parallel j16) \\ = j4 \parallel (j4 + j3.81) = j4 \parallel j7.81 = j2.65$$

$$z_{34} = z_{44} \left( \frac{V_3}{V_4} \right) = j2.65 \left( \frac{5 \parallel 16}{5 \parallel 16 + 4} \right) = j2.65 \left( \frac{3.81}{3.81+4} \right) = j1.293$$

$$z_{14} = z_{34} \left( \frac{V_1}{V_3} \right) = j1.293 \left( \frac{8}{8+2+6} \right) = j0.647 \quad \leftarrow \text{checks}$$

Clearly show all work needed to obtain your answer.

Use the definition of Z-matrix elements to find matrix elements  $z_{11}$ ,  $z_{12}$ ,  $z_{13}$ ,  $z_{14}$ .

$$j6 || j2 = j \left[ \frac{2 \cdot 6}{2+6} \right]$$

$$= j \frac{12}{8} = j1.5$$

$$\underline{z_{11}} = j6 || (j3 + j5 + j1.5) = j6 || j9.5 = \underline{j3.68}$$

$$\underline{z_{12}} = z_{21} = z_{11} \left( \frac{V_2}{V_1} \right) = j3.68 \left( \frac{5+1.5}{3+5+1.5} \right) = \underline{j2.52}$$

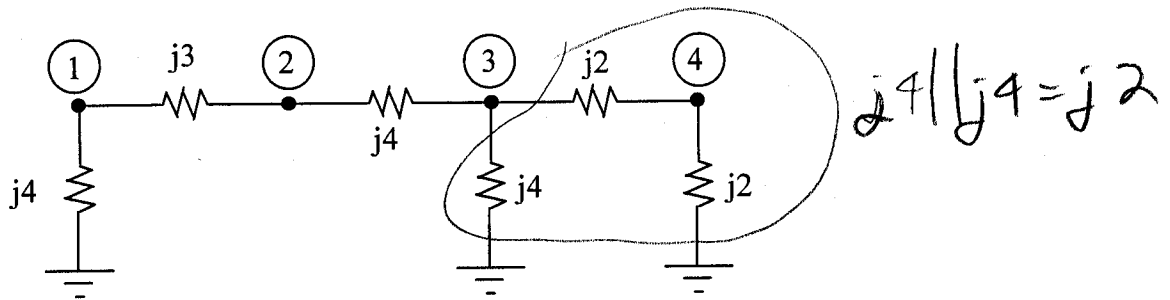
↑  
voltage  
divider

$$\underline{z_{13}} = z_{31} = z_{11} \left( \frac{V_3}{V_1} \right) = j3.68 \left( \frac{1.5}{3+5+1.5} \right) = \underline{j0.581}$$

$$\underline{z_{14}} = z_{41} = z_{31} \left( \frac{V_4}{V_3} \right) = j0.581 \left( \frac{3}{3+3} \right) = \underline{j0.291}$$

Clearly show all work needed to obtain your answer.

Use the definition of Z-matrix elements to find matrix elements  $z_{11}$ ,  $z_{12}$ ,  $z_{13}$ ,  $z_{14}$ .



$$z_{11} = j4 \parallel (j3 + j4 + j2) = j4 \parallel j9 = j2.77$$

$$z_{12} = z_{21} = z_{11} \left( \frac{V_2}{V_1} \right) = j2.77 \left( \frac{4+2}{3+4+2} \right) = j1.847$$

$\uparrow$   
 $\frac{V_1}{I_1}$

$$z_{13} = z_{31} = z_{11} \left( \frac{V_3}{V_1} \right) = j2.77 \left( \frac{2}{3+4+2} \right) = j0.616$$

$$z_{14} = z_{41} = z_{31} \left( \frac{V_4}{V_3} \right) = j0.616 \left( \frac{2}{2+2} \right) = j0.308$$

$\uparrow$   
 $\frac{V_3}{I_1}$